[0011] Accordingly, it would be advantageous to introduce display configurations that overcome certain disadvantages of existing technologies.

SUMMARY OF THE INVENTION

[0012] It is an object of the present disclosure, therefore, to describe various features of a collapsible display device and methods of using the same. In particular, one aspect of the disclosure includes a method and apparatus in which a deformable display membrane, such as an electric or electronic paper, has one or more sections that are bended, folded, twisted or otherwise deformed about at least one axis. The axis may coincide with a support member, such as a rib or support arm. When a section is collapsed about its respective axis, the collapsed section forms a first geometric shape having a first, smaller area. When the collapsed section is expanded about the axis, the expanded section forms a second geometric shape having a second area greater than the first area.

[0013] In various embodiments of the present disclosure, the first geometric shape may be a different shape than the second shape. For example, when all sections of the display device are expanded or fully-extended, the display device may be any of a variety of fan shapes. When each section is then collapsed, the display device may form a second shape, such as a rectangle that occupies a smaller area. In such manner, the entire display, as well as its individual sections, are expanded and collapsed to occupy two distinct areas. Geometries other than fan shapes may be used, such as general polygons or oval shapes.

[0014] In further embodiments, the first and second geometric shapes may be similar or identical, although the area of the first collapsed configuration will still occupy a smaller area than the second expanded configuration. For example, the first and second shapes may both be the same class of arcuate shapes, such as circles, ovals or ellipses, but with differing diameters.

[0015] In additional embodiments, the display device may have an operable visual display area that is less than or substantially equal to the area of the expanded display device. Furthermore, each collapsible section of the display may contain all or a portion of the total display area. The display area may also be a different shape than the display device itself. For example, an expanded display device may be fan-shaped and the display area may be rectangular, in order to conform with current standard display configurations.

[0016] In still further embodiments, the display device may be provided separately or may be integrated with any of the following: a portable electronic device, a wireless receiver, or any other type of device for providing display instructions thereto. When expanded, the display device may be greater in length and/or width than the electronic device to which it is attached. When collapsed, the display device may be partially or fully retracted into the attached electronic device. An integrated display device may be provided in various orientations with the electronic device, and may extend from a side or corner thereof. An electronic device may also include more than one such integrated display. Alternatively, the display device may receive display instructions remotely, such as by wireless signal, or may include a display wand or the like to activate the display.

[0017] In various embodiments, the collapsible display device may be fully expanded and collapsed with a single physical action. For example, one or more buttons or other controls may be provided for collapsing and expanding the deformable sections.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Further aspects of the present disclosure will be more readily appreciated upon review of the detailed description of its various embodiments, described below, when taken in conjunction with the accompanying drawings, of which:

[0019] **FIG. 1** is an illustration of an existing roll-up display;

[0020] **FIGS. 2 and 3** are illustrations of existing fold-up display configurations;

[0021] **FIG. 4** is an illustration of an exemplary deformable electronic display membrane for use with the present disclosure;

[0022] **FIG. 5** is an illustration of a folding fan configuration for a display;

[0023] **FIG. 6** is an illustration of brisé fan configuration for a display;

[0024] **FIG. 7** is an illustration of various configurations of a fan-shaped display according to certain embodiments of the present disclosure;

[0025] **FIG. 8** is an illustration of further embodiments of a fan-shaped display extending from a corner of an electronic device;

[0026] **FIG. 9** is an illustration of various rectangular visual display areas on a fan-shaped display;

[0027] **FIG. 10** is an illustration of various embodiments of dual fan-shaped displays for an electronic device;

[0028] **FIG. 11** is an illustration of alternate embodiments of a folding display;

[0029] **FIG. 12** is an illustration of a twist up configuration for a display;

[0030] **FIG. 13** is an illustration of an expanded umbrella configuration for a display;

[0031] **FIG. 14** is an illustration of a collapsed umbrella configuration for the display of **FIG. 13**; and

[0032] **FIG. 15** is an illustration of a display wand for use with a collapsible display.

DETAILED DESCRIPTION OF THE SPECIFIC EMBODIMENTS

[0033] Referring now to **FIGS. 4-15**, wherein similar components of the present disclosure are referenced in like manner, various embodiments of a collapsible display will be more particularly described.

[0034] In order for a collapsible display membrane to be operable, it must be sufficiently rigid so as to provide a constant display area, yet sufficiently flexible so as to allow individual sections of the display to be bended, folded, twisted, collapsed or otherwise deformed, where required. **FIG. 4** shows one embodiment of a deformable display